

# **USDOT Connected Vehicle Overview**

## **RWM Stakeholder Meeting**

**August 8, 2012**

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Joint Program Office, RITA, U.S. DOT

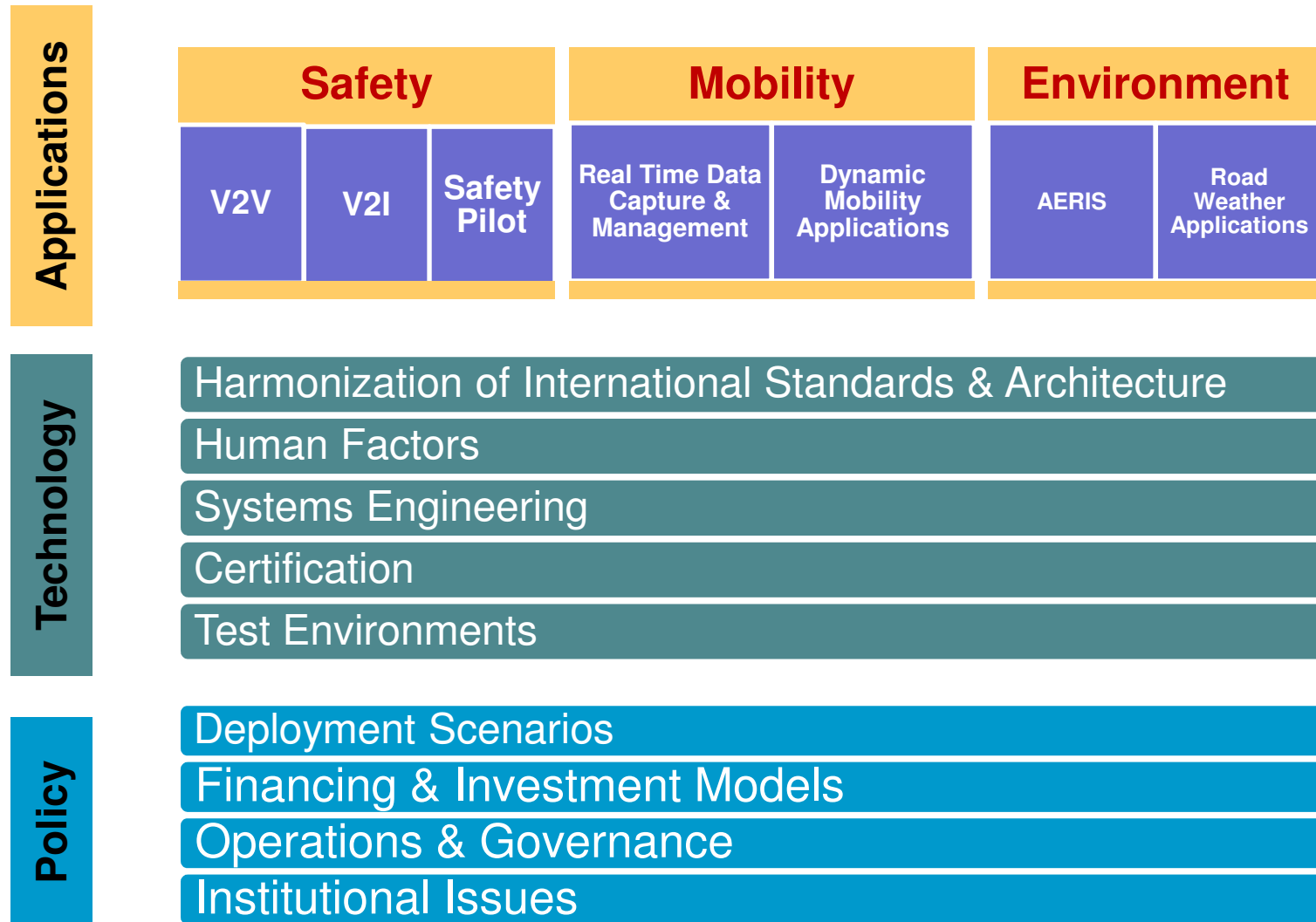
# Overview

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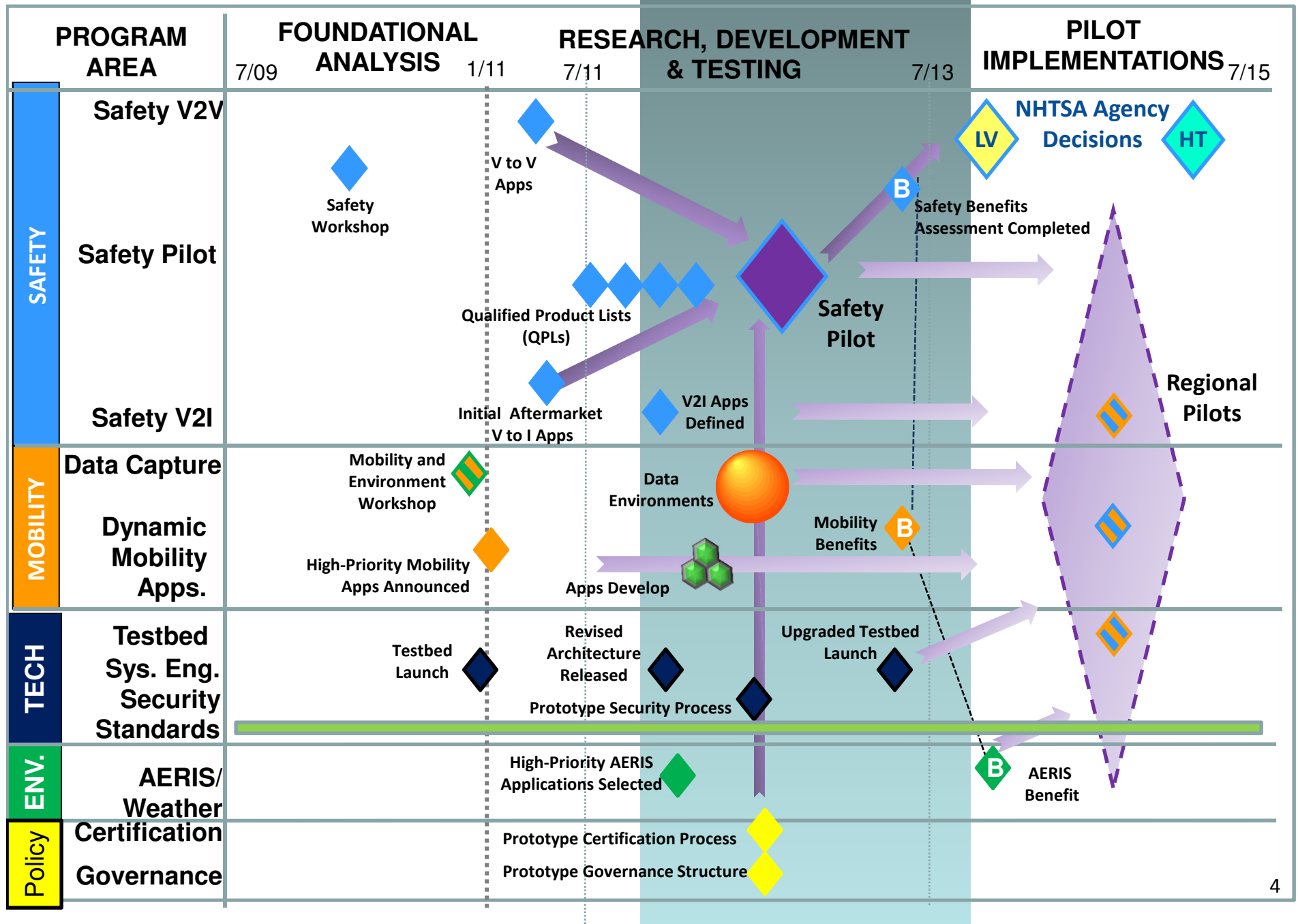
- NHTSA Decision
- Safety Pilot
- Policy-Architecture Issues
- Mobility Program
- Basic Safety Message (BSM)

# ITS Research Program Components

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# Major Milestones



# Safety Pilot - Objectives

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- Generate empirical data for supporting 2013 and 2014 decisions
- Show capability of V2V and V2I applications in a real-world operating environment using multiple vehicle types
- Determine driver acceptance of vehicle-based safety warning systems



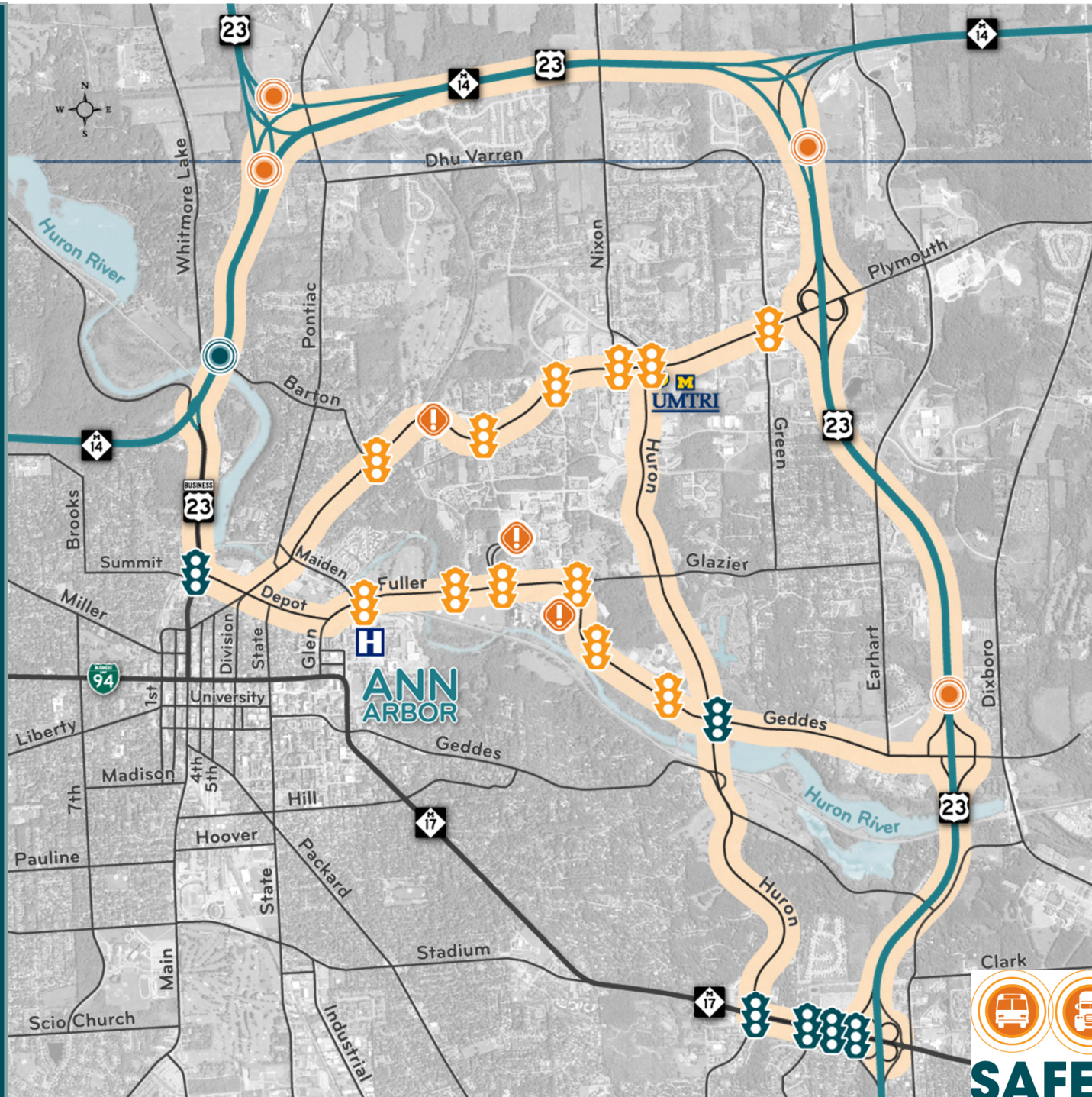
## Safety Pilot - Objectives (cont)

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- Assess options for accelerating the safety benefits through aftermarket and retrofit safety devices
- Extend the performance testing of the DSRC technology
- Collect lots of data and make it available for industry-wide use
- Let others leverage the live operating environment



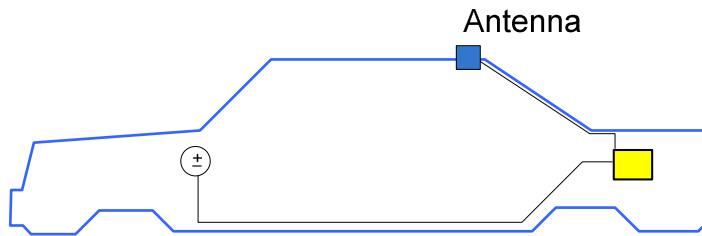




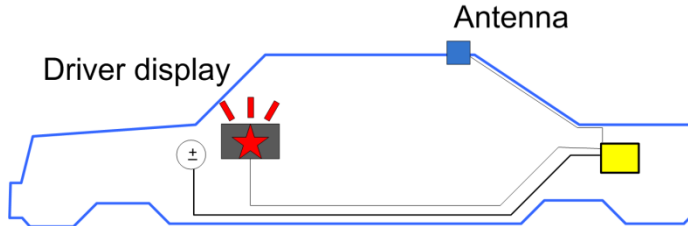
# Device Installation Examples

## (Passenger vehicles - Drivers' own vehicles)

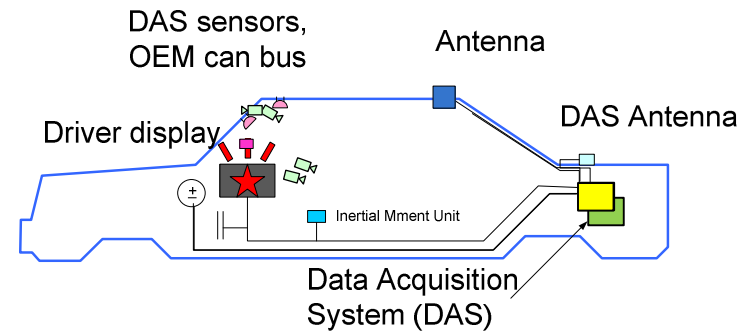
Vehicle Awareness Device



Aftermarket Safety Device



Aftermarket Safety Device with Data Acquisition System (DAS)



Data Acquisition from:  
Aftermarket device  
Radar or ranging device(s)  
4 cameras, microphone  
OEM CAN bus data  
Vehicle motion  
Cell & GPS antennas





# Commercial Vehicle Fleets

## (3 Integrated Trucks, 16 Retrofits, ~50 VADs)

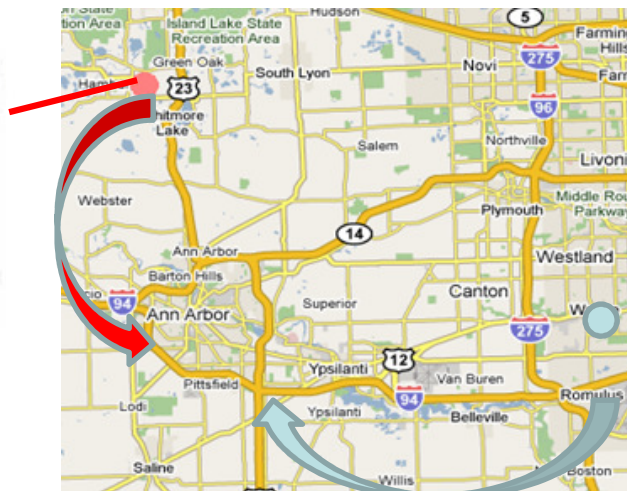
### Con-way Freight

- Less-than-truckload carrier (daytime pickup/delivery, nighttime line-haul)
- UMTRI/DOT partner in past projects



### Sysco Detroit LLC

- Food-service products for restaurants, schools, etc.
- Mix of tractors, trailers



**MODEL DEPLOYMENT**



U.S. Department of Transportation  
Research and Innovative Technology Administration

# Transit Vehicle Fleets

## (3 Integrated Buses, ~100 Vehicle Awareness Devices)

### Ann Arbor Transit Authority

- Operates 67 buses
- Active in national programs



### University of Michigan

- Operates 61 buses
- Model deployment area spans two separate campuses with high bus traffic between and within.



## MODEL DEPLOYMENT



U.S. Department of Transportation  
Research and Innovative Technology Administration

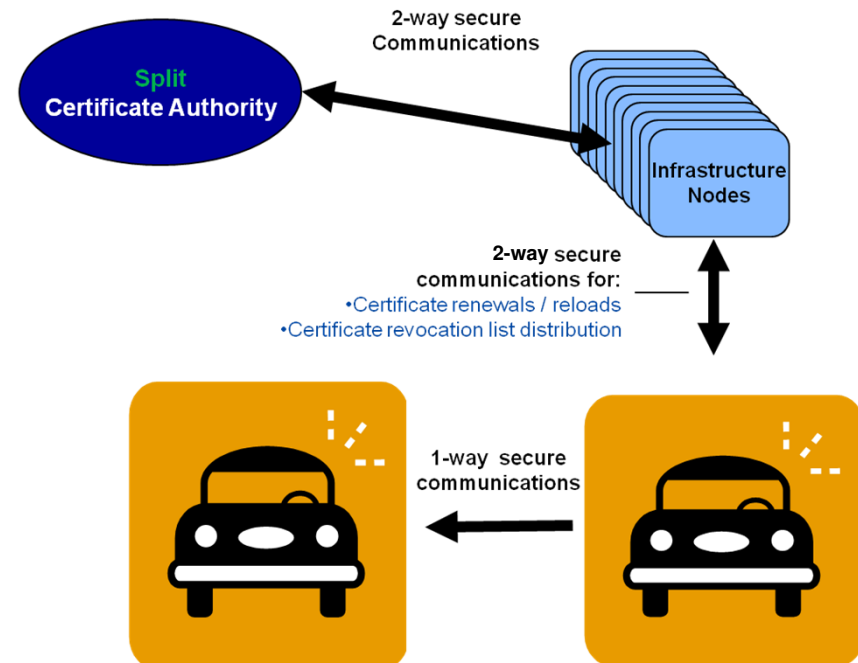
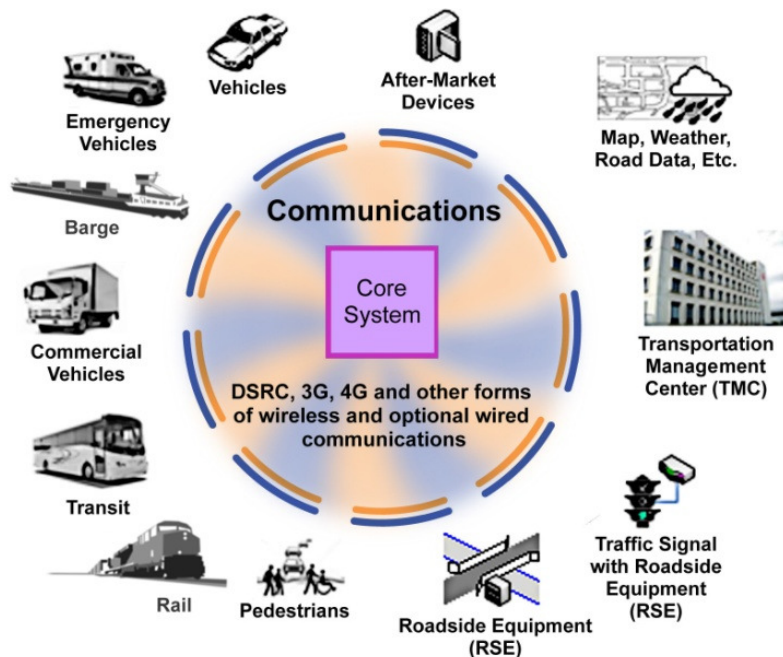
# Policy Research Focus

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- **Determine if V2V is feasible to implement**
  - **Security Needs**
    - Functional Requirements
    - Physical/Technical Requirements
    - Operational & Organizational Requirements
    - Financial Sustainability and Responsibility

# Policy - Security Network

- The V2V/V2I system requires communications media for two critical purposes:
  - Secure communications for distribution of certificates and revocation lists to make sure that entities on the system are legitimate users
  - Trusted communications for delivering safety application data and messages (and, potentially, other applications and services)



# Critical Questions

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- **Which communications media can support the needs for distributing security certificates? Choices include:**
  - Existing Cellular Networks
  - Dedicated Short Range Communications (DSRC)
  - WiFi
  - Vehicle-Based Security Option
- **What are advantages and limitations of each?**
- **How should the organizational functions of security certificate distribution and management be structured?**
  - Who should be responsible for them and how should they be funded initially and over time?

# Supportable Operationally – Certificate Management

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- **Develop Certificate Management Organizational/Operational Models:**
  - Roles and responsibilities
  - Organizational models
- **Project Schedule:**
  - Options due in winter 2011
  - Public meeting in April 2011 (for organizational analysis and network options – interim analysis for both projects)
  - Prototype testing: June 2012
  - Test Results and Evaluation of Approach: Jan 2013
  - Final Report: July 2013



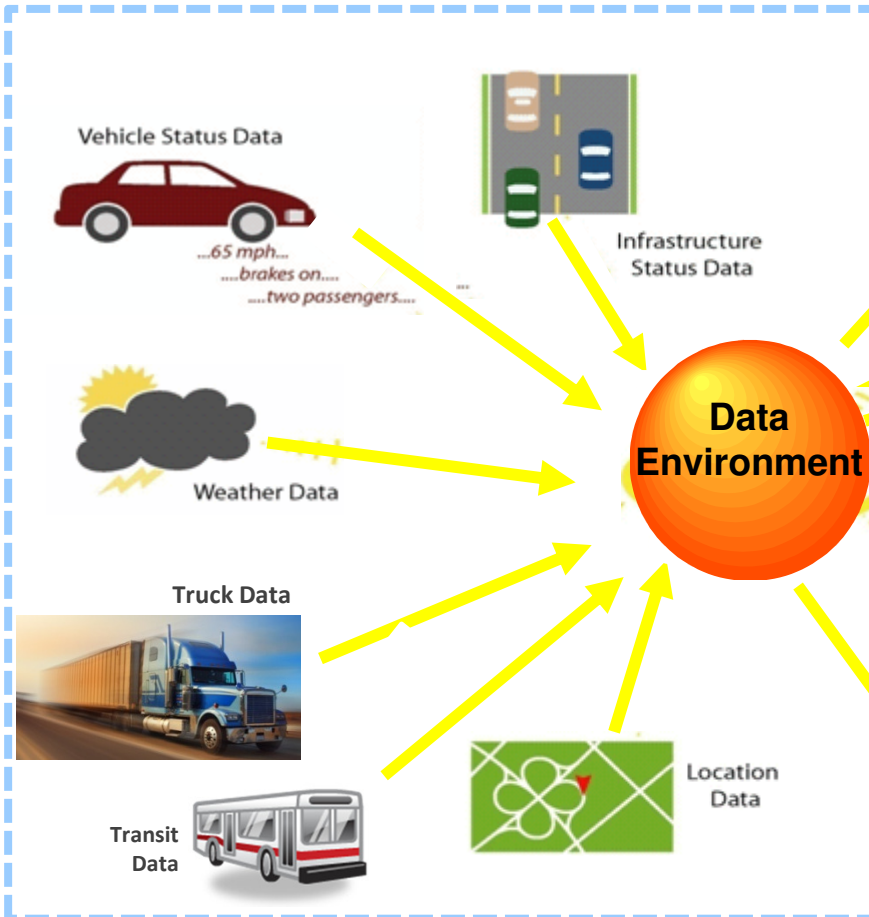
# Supportable Operationally – Financial Models

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- **All security network options require financing for operational support**
  - **All public** – politically feasible?
  - **Public/private partnership** – what type of framework?
  - **All private** – where's the value?
    - Data
    - Transactions
    - Spectrum
    - Other

# Mobility Program

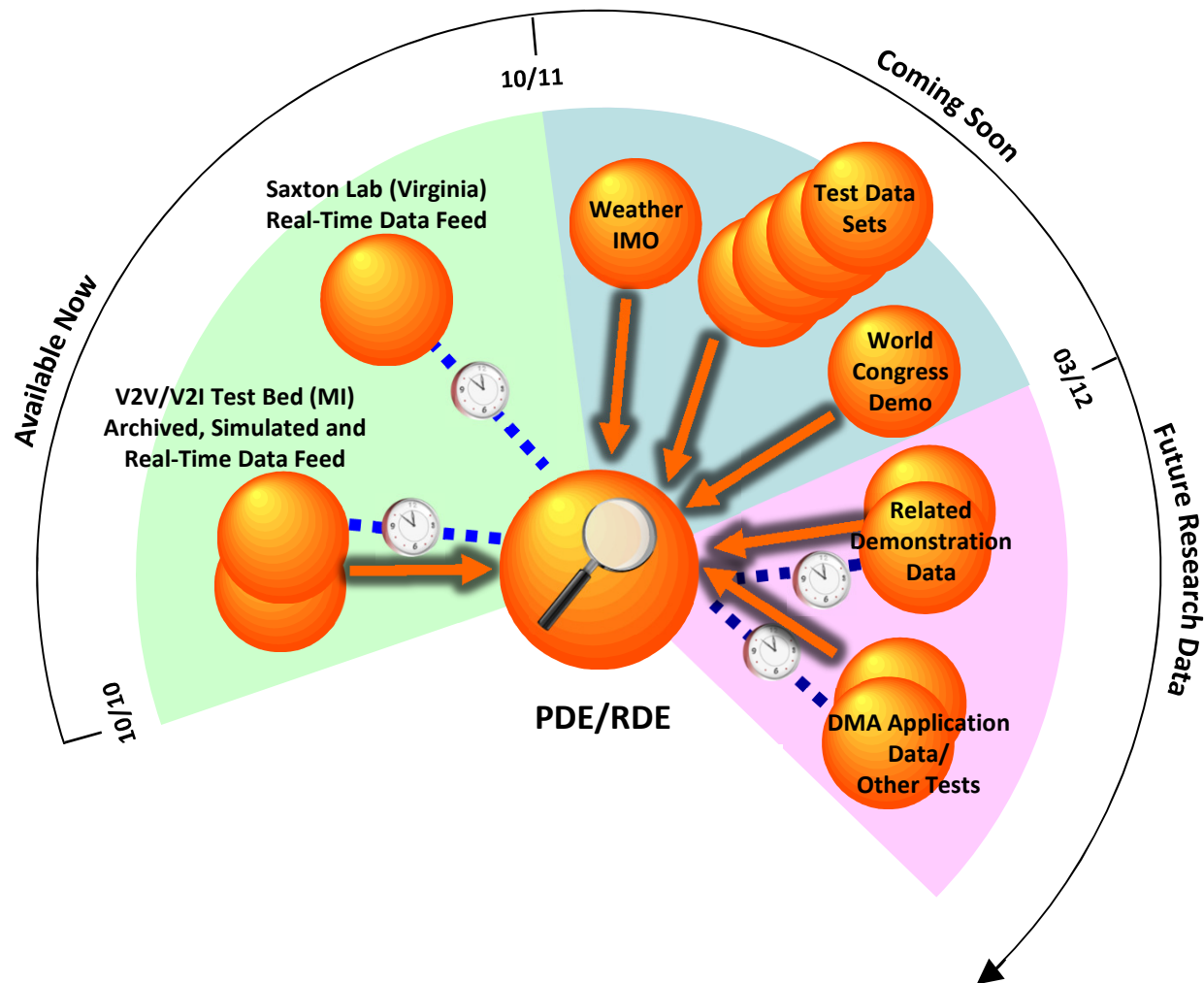
## Real-time Data Capture and Management



## Dynamic Mobility Applications



# Data Capture and Management: Near-term Data Products











## Data Capture and Management – Key Issue

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- Assessment of Data Elements in the SAE J2735 - Basic Safety Message
  - What can we do with the Data if delivered only via DSRC (Density of roadside locations to be effective)?
  - What can we do if the data is delivered via other communication media?
  - Are there other critical data elements?
- Do we need to modify the SAE J2735 Probe Data Message Process and do we need to develop a performance criteria standard?

# High-Priority Dynamic Mobility Applications

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- High priority mobility applications identified (many also have safety impact) 
-  Coordinated Adaptive Cruise Control
-  Speed Harmonization
-  Queue Warning
- Intelligent Traffic Signal System
- Transit Signal Priority
-  Mobile Accessible Pedestrian Signal System
-  Emergency Communications and Evacuation
-  Accident Scene Pre-Arrival Staging Guidance for Emergency Responders
-  Accident Scene Work Zone Alerts for Drivers and Workers

# High-Priority Dynamic Mobility Applications (2 of 2)

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- Next Generation Integrated Corridor Management
- Transit Connection Protection
- Dynamic Transit Operations
- Dynamic Ridesharing
- Freight Traveler Information
- Traveler Information



# Basic Safety Message (BSM) Fundamentals

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- Connected V2V safety applications are built around the BSM, which has two parts
  - BSM Part 1:
    - Contains the core data elements (vehicle size, position, speed, heading acceleration, brake system status)
    - Transmitted approximately 10x per second
  - BSM Part 2:
    - Added to part 1 depending upon events (e.g., ABS activated)
    - Contains a variable set of data elements drawn from many optional data elements (availability by vehicle model varies)
    - Transmitted less frequently
  - No on-vehicle BSM storage of BSM data
  - The BSM is transmitted over DSRC (range ~1,000 meters)
- **The BSM is tailored for low latency, localized broadcast required by V2V safety applications**

# Mobility Programs:

## BSM Assessment Activity

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- Assess the extent to which the BSM supports or enables mobility applications
  - To what degree is a DSRC-based BSM Part 1 message critical to realizing transformative benefits from mobility applications?
  - What key elements of BSM Part 2 or other vehicle-based data might be needed? Where and how often?
  - Can other messages tailored for cellular communication augment a DSRC-based BSM?
  - As we add data from mobile devices and fixed sensors, how much improvement do we see in application effectiveness?

# Role of BSM Part 1 Via DSRC In Support of Mobility Applications

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- **BSM Part 1 via DSRC provides the vehicle data needed to support a few mobility applications that require low latency and localized broadcast exchange**
  - Cooperative Adaptive Cruise Control
  - Queue Warning
- These applications will likely be successful wherever DSRC-capable roadside infrastructure (RSEs) is deployed
  - Key intersections
  - Major interchanges

# Key Elements of BSM Part 2 Needed for Mobility Applications

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- BSM Parts 1 and 2 via DSRC provides the vehicle data needed to support some localized mobility applications

MOBILITY APPLICATIONS (where roadside units deployed)	KEY PART 2 DATA ELEMENTS TO SUPPLEMENT PART 1 DATA
<ul style="list-style-type: none"><li>▪ Cooperative Adaptive Cruise Control</li><li>▪ Speed Harmonization</li><li>▪ Queue Warning</li><li>▪ Transit Signal Priority</li><li>▪ Incident Scene Work Alerts</li></ul>	<ul style="list-style-type: none"><li>▪ Weather Data (with examples)<ul style="list-style-type: none"><li>▫ Ambient Temperature</li><li>▫ Ambient Air Pressure</li><li>▫ Traction Control Status</li><li>▫ Wiper Status</li></ul></li><li>▪ Vehicle Data (with examples)<ul style="list-style-type: none"><li>▫ Exterior Lights Status</li><li>▫ Type</li><li>▫ Antilock Brake System Status</li></ul></li></ul>

- **HOWEVER: DSRC link burdened by redundant Part 2 elements**

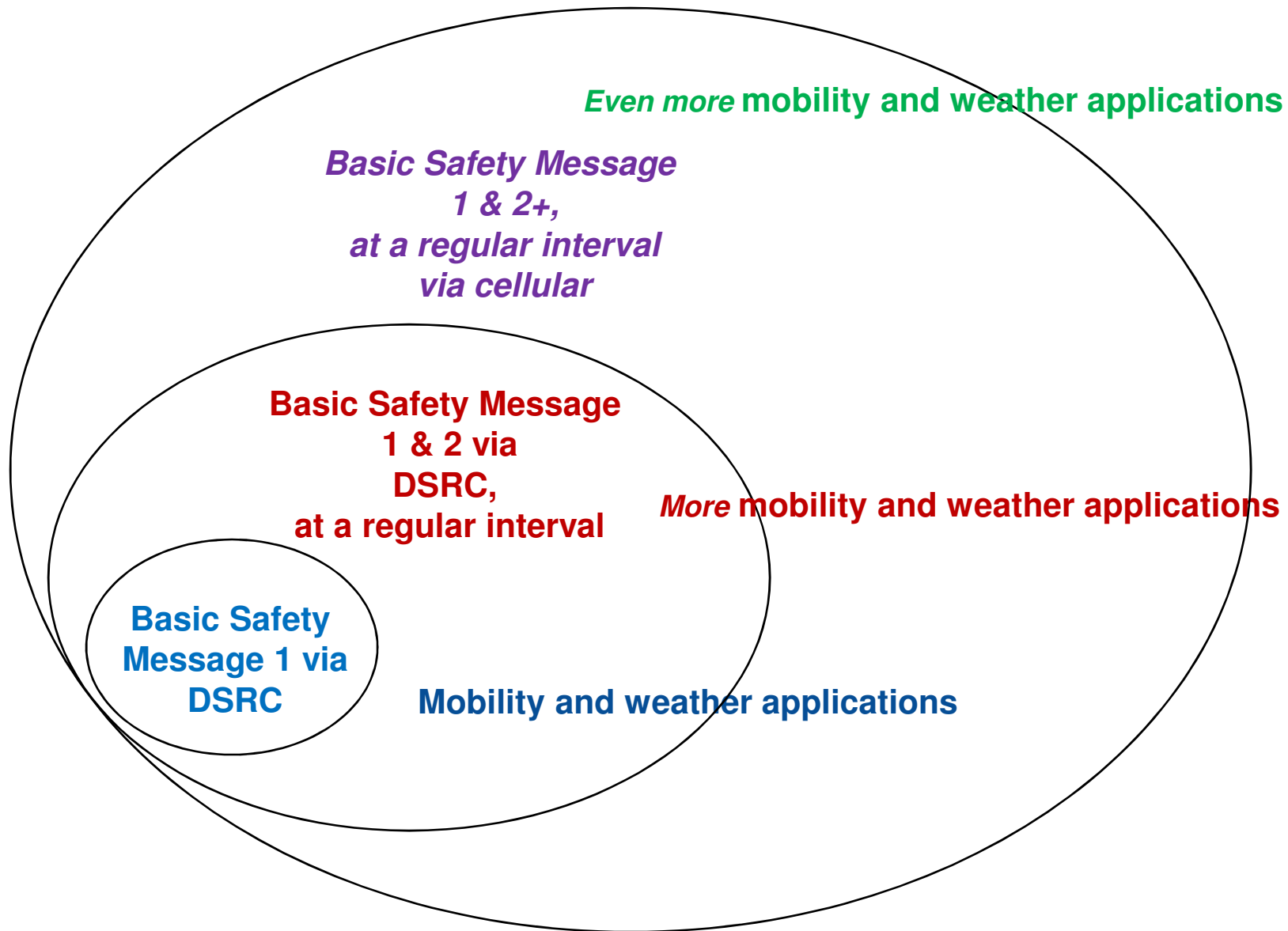
# Using Cellular Messages to Augment BSM for Mobility Applications

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- Most mobility applications do not require BSMs 10 times per second
- Many applications require data captured over a wide area, not just localized data near a roadside unit (storage and/or wide-area communications needed)
- Possible Approach:
  - Vehicles transmit BSM Part 1 plus key Part 2 elements less frequently
  - Transmit via DSRC when available, Cellular otherwise
- **Augmenting BSM with key Part 2 elements via Cellular provides the vehicle data needed to support nearly all mobility applications**
  - Cooperative Adaptive Cruise Control
  - Speed Harmonization
  - Queue Warning
  - Intelligent Traffic Signal System
  - Transit Signal Priority
  - Mobile Accessible Pedestrian Signal System
  - Emergency Communications and Evacuation
  - Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
  - Incidents Scene Work Zone Alerts for Drivers and Workers
  - Next Generation Integrated Corridor Management
  - Transit Connection Protection
  - Dynamic Transit Operations
  - Dynamic Ridesharing
  - Freight Traveler Information
  - Traveler Information

# Data Question

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# Summary of Initial Assessment: BSM and Mobility Applications

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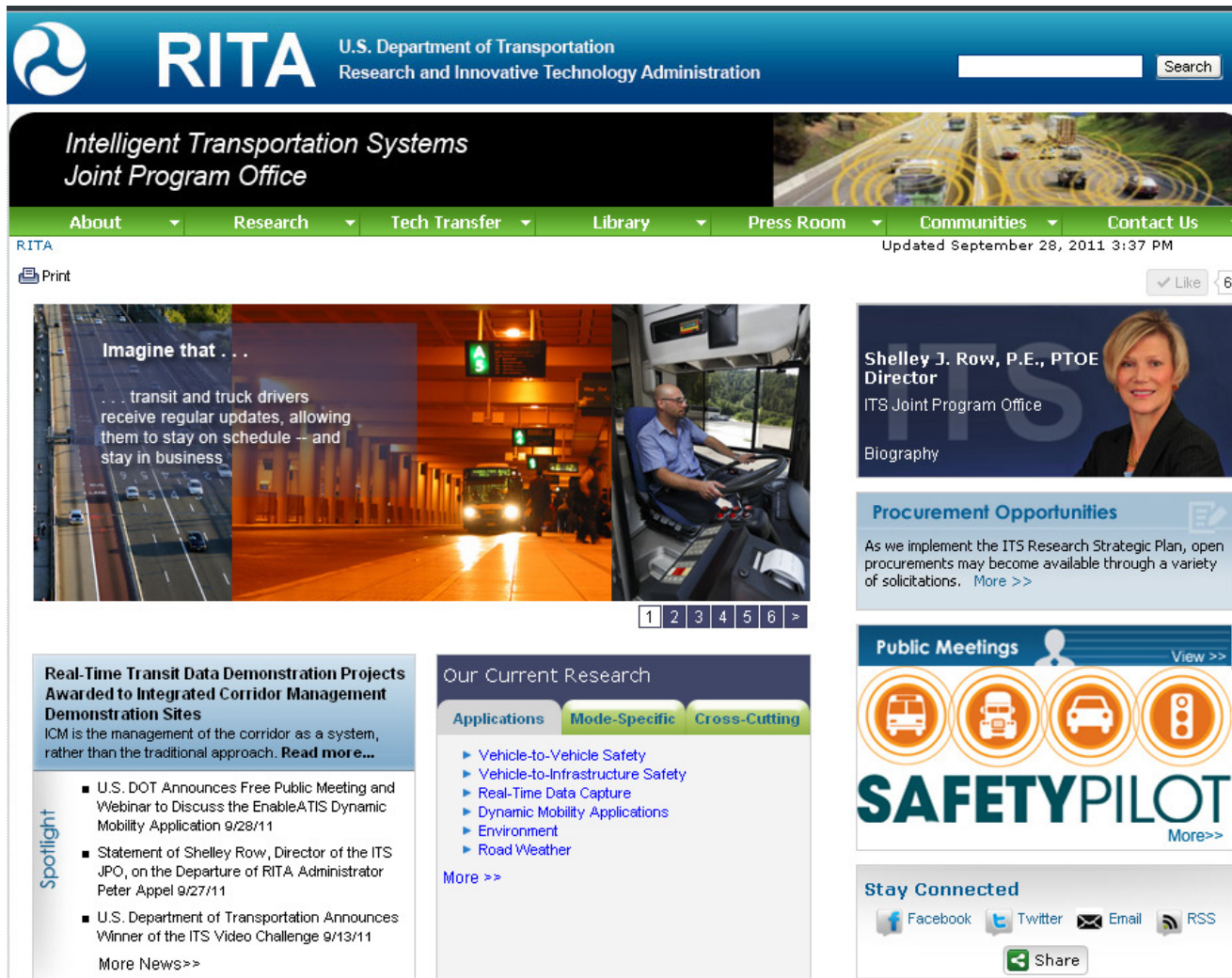
- The Mobility Program (DCM/DMA) is currently engaged in a research program intended to identify:
  - Key Part 2 and other vehicle-based data elements required by high-priority mobility applications
    - Required frequency and latency
    - Likelihood of OEMs to share these data
  - Need to store data on vehicles
  - Targeted use of triggers to reduce data redundancy
  - In conjunction with the safety program, identify business and financial models to support deployment
  - Examine vehicle data needs in light of additional data from mobile devices and fixed sensors

# **Mobility Program: Schedule of BSM-Related Next Steps**

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- Updates to BSM Role Assessment Research
  - May 2012: Application ConOps Update
  - September 2012: BSM Data Analysis Update
  - May 2013: Impacts Assessment – Benefit/Cost Update
  
- Stakeholder Engagement
  - OEM Engagement – through VIIC
  - AASHTO Engagement – through Pooled Fund Study
  
- BSM Data Analysis
  - Safety Pilot Model Deployment
  - Mobility-related Technology Testing

# For More Information



The screenshot shows the RITA (Research and Innovative Technology Administration) website. The header features the RITA logo and the text "U.S. Department of Transportation Research and Innovative Technology Administration". Below the header is a navigation bar with links: About, Research, Tech Transfer, Library, Press Room, Communities, and Contact Us. A search bar is also present. The main content area includes a large banner for "Intelligent Transportation Systems Joint Program Office" with a background image of a highway. Below the banner is a "Print" button and a "Like" button with a count of 67. The main content area is divided into several sections: "Imagine that..." with a video player, "Real-Time Transit Data Demonstration Projects Awarded to Integrated Corridor Management Demonstration Sites" with a list of news items, "Our Current Research" with a list of research topics, "Public Meetings" with a "View >>" link, "SAFETYPILOT" with a "More>>" link, and "Stay Connected" with social media links for Facebook, Twitter, Email, and RSS, and a "Share" button.

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Imagine that . . .  
... transit and truck drivers  
receive regular updates, allowing  
them to stay on schedule -- and  
stay in business.

1 2 3 4 5 6 >

**Real-Time Transit Data Demonstration Projects  
Awarded to Integrated Corridor Management  
Demonstration Sites**  
ICM is the management of the corridor as a system,  
rather than the traditional approach. [Read more...](#)

**Spotlight**

- U.S. DOT Announces Free Public Meeting and Webinar to Discuss the EnableATIS Dynamic Mobility Application 9/28/11
- Statement of Shelley Row, Director of the ITS JPO, on the Departure of RITA Administrator Peter Appel 9/27/11
- U.S. Department of Transportation Announces Winner of the ITS Video Challenge 9/13/11

[More News>>](#)

**Our Current Research**

Applications Mode-Specific Cross-Cutting

- ▶ Vehicle-to-Vehicle Safety
- ▶ Vehicle-to-Infrastructure Safety
- ▶ Real-Time Data Capture
- ▶ Dynamic Mobility Applications
- ▶ Environment
- ▶ Road Weather

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